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HYDRAULIC DESIGN OF SILT SELECTIVE
HEAD REGULATOR FOR SEDIMENT
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CRITERIA FOR HYDRAULIC DESIGN OF SILT SELECTIVE HEAD REGULATOR FOR SEDIMENT CONTROL IN OFFTAKING CANALS

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CRITERIA FOR HYDRAULIC DESIGN OF SILT SELECTIVE HEAD REGULATOR FOR SEDIMENT CONTROL IN OFFTAKING CANALS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 1 October 1974, after the draft finalized by the Canals and Canal Linings Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 The total sediment load carried by any flow can be divided into two parts; the bed load comprising of particles essentially in contact with the bed and the suspended load, comprising of particles in suspension. The sediment particles near the bottom are much coarser than those in upper layers. Preventing the entry of this coarser bed sediment and allowing admission of the quantity of silt according to the carrying capacity of the offtaking canals are the principal aims of all sediment control measures.

0.3 Sediment exclusion in the case of a main canal offtaking from a river slightly differs from that in a distributory head offtaking from a canal. In the former complete sediment exclusion can be aimed at as the river can dispose of its silt by passing it down into the sea. In a distributory, on the other hand, it is the proportionate distribution of sediment according to the silt carrying capacity of the canal which should be achieved as the canal cannot dispose of any excess silt.

0.4 This standard is based on some of the structures constructed in Lower Jhelum Canal Distributory (now in Pakistan). Data from hydraulic model studies and similar prototype structures constructed in India may be collected and sent to ISI to enable the Institution to improve and review the standard.

1. SCOPE

1.1 This standard covers the criteria for hydraulic design of silt selective head regulator for sediment control in offtaking canals.

2. TERMINOLOGY

2.0 For the purpose of this standard the following definitions shall apply.

2.1 Critical Velocity Ratio — The ratio of the critical velocity for a certain grade of silt to that estimated by Kennedy's formula for a standard silt.

2.2 Kennedy's Critical Velocity — The velocity of flow in open channels which will not permit silting or scouring.

2.3 Silt Conductive Power (of Offtake) — The ratio of the silt charge (by weight) of offtaking canal to the silt charge of the parent canal.

3. GENERAL

3.1 Silt selective head is an efficient regulator by means of which only silt conforming to the silt conductive power of the offtaking canal is allowed to be taken into it. It consists of three parts, namely, the approach chamber, the regulator and the flume as shown in Fig. 1. The design of the approach chamber is the most vital part of this type of head upon which the efficiency of the structure chiefly depends.

4. DESIGN OF APPROACH CHAMBER

4.1 Depth of Flow — The depth of flow in the approach chamber shall be calculated from the following expression:

$$r_1 = \left[\frac{H_a}{d_u} \right]^{\frac{1}{3}}$$

where

r_1 = silt conductive power in offtaking canal (see 4.1.1),

H_a = depth of flow in the approach chamber in m, and

d_u = depth in parent channel in m.

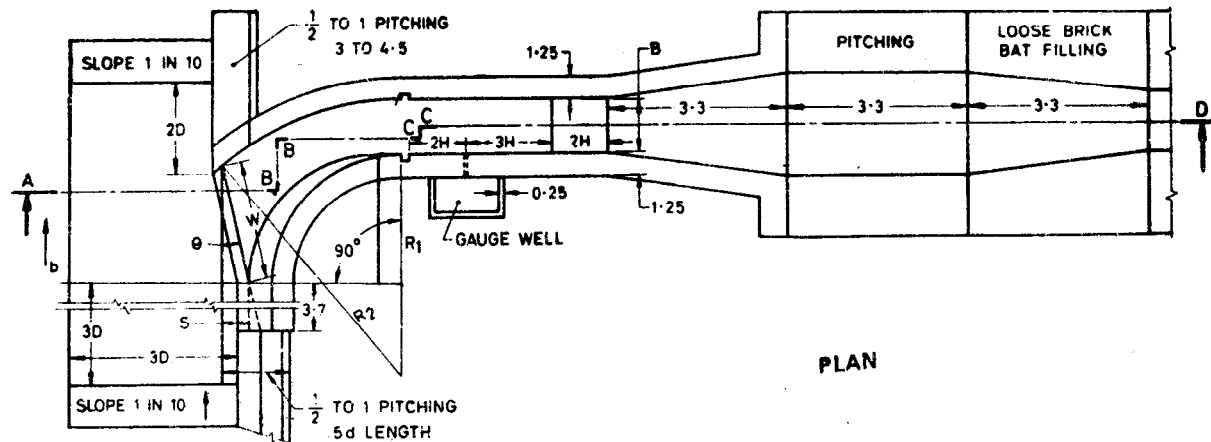
4.1.1 Silt conductive power of offtaking canal is obtained from the following expression:

$$R = (r_1)^{0.68} (\lambda)^{\frac{1}{8}}$$

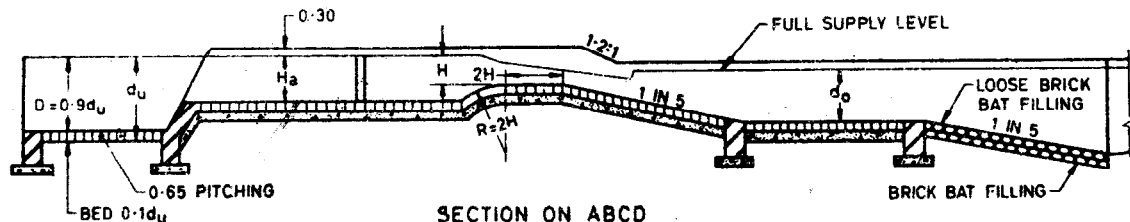
where

R = $\frac{\text{critical velocity ratio in the offtaking canal}}{\text{critical velocity ratio in the parent canal}}$, and

λ = $\frac{\text{depth in the parent canal}}{\text{depth in the offtaking canal}}$



PLAN



SECTION ON ABCD

Depth in canal $= d_u$
 Bed width in canal $= b$
 Depth of the offtake $= d_o$
 Depth in front of offtake head $= D$
 Depth in approach chamber $= H_a$
 Projection of the D. S. wing $= S$
 Width of approach $= W$

Radius of U.S. side wall of approach chamber $= R_1$
 Radius of U.S. outer wing wall $= R_2$
 Width of flume (B) $= 2/3 W$
 Head over crest (H) $= (Q_1 / 1.71 b)^{2/3}$
 Distance of gauge well hole from beginning of crest $= 3 H$
 Length of crest $= 2 H$
 $\theta = \sin^{-1} S/W$

All dimensions in metres.

FIG. 1 SILT SELECTIVE HEAD REGULATOR FOR A DISTRIBUTARY

4.2 Width of Approach Chamber — The width required for the approach chamber shall be calculated from the following formula:

$$W = K \frac{S \times d_u}{H_u}$$

where

W = width of approach chamber;

$K = C \operatorname{coversine} \theta_{\frac{1}{2}} \times \operatorname{coversine} \phi_{\frac{1}{2}}$ a constant generally varying from 1.5 to 2.0 [C = constant = 2.0, $\theta = \sin^{-1} \left(\frac{S}{W} \right)$ that is, inclination of the approach to the central line of the parent channel, and ϕ = inclination of the offtake to the normal of the parent channel]; and

S = setback of the upstream wing.

4.3 Setback of Upstream Wing — The setback of upstream wing shall be calculated from the formula:

$$S = \frac{Q_1}{Q_2} \left(b + \frac{d_u}{2} \right)$$

where

S = setback of the upstream wing,

Q_1 = discharge in offtaking canal,

Q_2 = discharge of the parent canal, and

b = bed width of the parent canal.

4.4 Radius of Wings — The radius of the upstream side wall of the approach chamber shall be 3 times the depth of flow in the chamber.

5. REGULATION

5.1 The width of the crest of the regulator shall be kept about 2/3 the width of the approach chamber.

5.2 The regulator shall have a straight approach channel of length equal to five times the head over crest.

5.3 Length of crest shall be equal to twice the head over crest H . The bed of the approach chamber shall be joined to the top of crest by a curve of radius equal to $2H$.

5.4 The crest shall be joined to the bed of the offtaking canal by a glacis with a slope of 1 in 5.

6. FLUMING

6.1 The width of regulator shall be widened to the bed width of the offtake through straight 1 in 5 splays starting from the downstream edge of the horizontal portion of the crest.